SPRING 1999 RELEASE ITEM
Grade 5 Mathematics

SAMPLE OPEN-RESPONSE QUESTION

How do students provide evidence of what they know and can do in mathematics?

The following is an example of an open-response question designed to provide an opportunity for students to show what they know and can do in the area of mathematics:

Highest/Lowest

Corina was investigating information about natural wonders of the world.

- She found that Mt. Everest is the highest mountain in the world. It is 29,028 feet ABOVE sea level.
- She found that the Marianas Trench in the Pacific Ocean is the lowest point on Earth. It is 35,840 feet BELOW sea level.

a. If Corina could throw a rock from the top of Mt. Everest to the bottom of the Marianas Trench, how many feet would it fall?

b. Draw a diagram and explain your answer for **part a**.

MATHEMATICS CONTENT

What is the relationship of the assessment to the curriculum?

The content of the open-response question "Highest/Lowest" addresses the following Mathematics Academic Expectations: "Students use mathematical ideas and procedures to communicate, reason, and solve problems" (1.5-1.9), and "Students understand number concepts and use numbers appropriately and accurately" (2.7).

This question provides a way for students to show their understanding of several concepts from the *Core Content for Mathematics Assessment*. Students are asked to demonstrate their understanding of the mathematical concepts of whole numbers, place value, addition, and subtraction, and what these concepts mean in the context of a mathematical problem or situation.

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PERFORMANCE EXPECTATIONS

How good is good enough?

An appropriate student response should provide evidence of the student's understanding of how and when to use various mathematical operations (i.e., addition and subtraction) to solve mathematical problems.

For example, an appropriate response to this question would show that the student can

- clearly understand the meaning of the mathematical operations of subtraction and addition;
- correctly assess which mathematical operation to use (i.e., addition or subtraction) to calculate the difference in feet between a point above sea level and a point below sea level;
- accurately use the mathematical operation of addition to determine the number of feet a rock would fall from the top of Mt. Everest to the bottom of the Marianas Trench (i.e., accurately add 35, 840 ft. and 29,028 ft.);
- draw a diagram that accurately translates the mathematical problem into a pictorial representation; and
- clearly explain in writing the method used to solve the problem.

Successful student work should provide convincing evidence that the student can use mathematical knowledge to address the relevant issue(s), although the response may not address all details and may contain minor mathematical errors.

APPLICATIONS

How is this relevant?

By successfully answering this question, students demonstrate an ability to correctly assess which mathematical operation (i.e., addition or subtraction) should be used to solve a mathematical problem and to use that operation correctly. This ability will be useful to students both in school (e.g., in mathematics and science courses) and in adult life (e.g., calculating temperature variations, distances, stock market gains/losses, or price differences).

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The following is an example of an open-response question designed to provide an opportunity for students to show what they know and can do in the area of mathematics:

Number Cubes

José created a game using two number cubes of different colors. The green cube had ODD multiples of 3 and the red cube had EVEN multiples of 3.

a. What was the color of the cube that had the number 6?

b. List SIX numbers that could be on the OTHER cube.

c. Could José design the same game using multiples of 4? Explain your answer.

MATHEMATICS CONTENT

What is the relationship of the assessment to the curriculum?

The content of the open-response question "Number Cubes" addresses the following Mathematics Academic Expectations: "Students use mathematical ideas and procedures to communicate, reason, and solve problems" (1.5-1.9), and "Students understand mathematical structure concepts including the properties and logic of various mathematical systems" (2.12).

This question provides a way for students to show their understanding of several concepts from the *Core Content for Mathematics Assessment*. Students are asked to demonstrate their understanding of the mathematical concepts of odd and even numbers and multiples of numbers and what these concepts mean in the context of a mathematical problem or situation.

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PERFORMANCE EXPECTATIONS

How good is good enough?

An appropriate student response should provide evidence of the student's ability to determine odd and even numbers and multiples of numbers to solve a mathematical problem.

For example, an appropriate response to this question would show that the student can

- clearly understand the concept of odd and even numbers;
- clearly understand the concept of multiples of numbers;
- correctly determine that the number 6 is an even multiple of 3 and, therefore, was on the red cube;
- correctly identify the red cube as having had the number 6;
- correctly identify six multiples of the number 3 that are odd numbers;
- correctly determine that Jose could not design the same game using multiples of 4; and
- clearly and correctly explain that no multiple of the number 4 is an odd number.

Successful student work should provide convincing evidence that the student can use mathematical knowledge to address the relevant issue(s), although the response may not address all details and may contain minor mathematical errors.

APPLICATIONS

How is this relevant?

By successfully answering this question, students demonstrate an ability to use the basic mathematical concepts of odd and even numbers and multiples of numbers to solve real-life problems. This ability will be useful to students throughout school (e.g., in math and science courses) and in adult life (e.g., determining multiples of items for pricing purposes; determining how to divide a set number of items among an odd or even number of recipients).

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SAMPLE OPEN-RESPONSE QUESTION

How do students provide evidence of what they know and can do in mathematics?

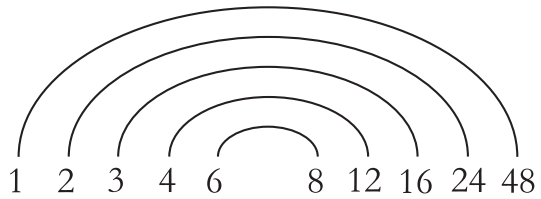
The following is an example of an open-response question designed to provide an opportunity for students to show what they know and can do in the area of mathematics:

Prime It

Mrs. Radford was showing her students how to find all the factors of a composite number by making RAINBOW PATTERNS. She used the numbers 48 and 50 to demonstrate the RAINBOW PATTERN. She then chose a pair of factors from each number to make FACTOR TREES.

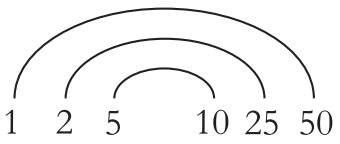
- She used RAINBOW PATTERNS to find all the factors.
- She used FACTOR TREES to find all the PRIME factors.

Rainbow Pattern for 48

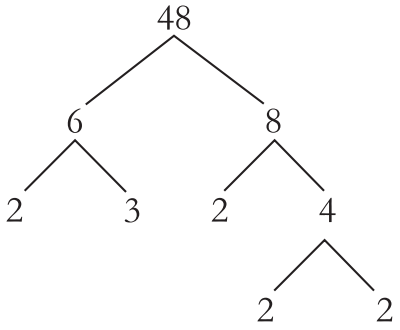


This RAINBOW PATTERN shows that 6 x 8 = 48, 4 x 12 = 48, 3 x 16 = 48, 2 x 24 = 48, and 1 x 48 = 48.

Rainbow Pattern for 50

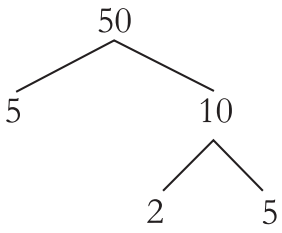


Factor Tree for 48



This FACTOR TREE shows that 2 and 3 are prime factors of 48 and that 2 x 3 x 2 x 2 x 2 = 48.

Factor Tree for 50



a. Choose a COMPOSITE number between 51 and 100.

b. Make a RAINBOW PATTERN that shows ALL the factors of the number you chose.

c. Pick ONE PAIR of factors of the number you chose in **part a**. Make a FACTOR TREE that shows all the prime factors of your chosen number.

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MATHEMATICS CONTENT

What is the relationship of the assessment to the curriculum?

The content of the open-response question "Prime It" addresses the following Mathematics Academic Expectations: "Students use mathematical ideas and procedures to communicate, reason, and solve problems" (1.5-1.9), and "Students understand number concepts and use numbers appropriately and accurately" (2.7).

This question provides a way for students to show their understanding of several concepts from the *Core Content for Mathematics Assessment*. Students are asked to demonstrate their understanding of the mathematical concepts of composite and prime numbers and factors of numbers and what these concepts mean in the context of a mathematical problem or situation.

PERFORMANCE EXPECTATIONS

How good is good enough?

An appropriate student response should provide evidence of the student's understanding of prime and composite numbers, factors of numbers, and organizational techniques for displaying factorization.

For example, an appropriate response to this question would show that the student can

- clearly understand the concept of prime and composite numbers;
- correctly identify a composite number between 51 and 100;
- correctly display all of the factors of the selected composite number using an organizational technique called a rainbow pattern;
- correctly identify all of the prime factors of the selected composite number; and
- correctly display all of the prime factors of the selected composite number using an organizational technique called a factor tree.

Successful student work should provide convincing evidence that the student can use mathematical knowledge to address the relevant issue(s), although the response may not address all details and may contain minor mathematical errors.

APPLICATIONS

How is this relevant?

By successfully answering this question, students demonstrate an understanding of basic mathematical concepts of composite and prime numbers and factors of numbers. The knowledge of these key concepts of mathematics will be valuable both in understanding number systems throughout the study of mathematics and in understanding how rules involving numbers and operations can be derived. Students may also use this knowledge in school and in adult life to compute with fractions, to solve algebraic equations, and to interpret mathematical concepts represented in graphic form.

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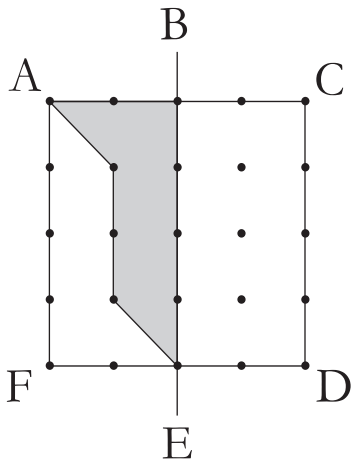
SAMPLE OPEN-RESPONSE QUESTION

How do students provide evidence of what they know and can do in mathematics?

The following is an example of an open-response question designed to provide an opportunity for students to show what they know and can do in the area of mathematics:

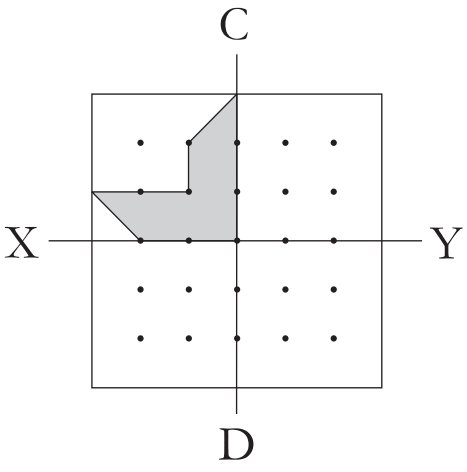
Making a Quilt

Alene and her grandmother are making a quilt using quilt squares of different symmetrical patterns.



a. ACDF is one quilt square they are using. Copy the whole quilt square into the top half of the grid in your Student Response Booklet. The line segment BE is a line of symmetry. ABEF is the left half of the quilt square. Draw the design that belongs in the right half of this square (BCDE).

b. Another quilt square they are using is shown below. A design is shown in $\frac{1}{4}$ of the quilt square. Copy the whole quilt square shown below into the bottom half of the grid in your Student Response Booklet. The line segments CD and XY are lines of symmetry. Draw the design that belongs in the other three parts of the quilt square.



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Grade 5 Mathematics

MATHEMATICS CONTENT

What is the relationship of the assessment to the curriculum?

The content of the open-response question "Making a Quilt" addresses the following Mathematics Academic Expectations: "Students use mathematical ideas and procedures to communicate, reason, and solve problems" (1.5-1.9), and "Students understand space and dimensionality concepts and use them appropriately and accurately" (2.9).

This question provides a way for students to show their understanding of several concepts from the *Core Content for Mathematics Assessment*. Students are asked to demonstrate their understanding of the mathematical concepts of symmetry and congruence, and what these concepts mean in the context of a mathematical problem or situation. Students are also asked to demonstrate their understanding of how to use symmetry to construct geometric designs.

PERFORMANCE EXPECTATIONS

How good is good enough?

An appropriate student response should provide evidence of the student's understanding of how and when to use various mathematical geometry concepts (i.e., symmetry and congruence) to solve mathematical problems.

For example, an appropriate response to this question would show that the student can

- clearly understand the concepts of symmetry and congruence;
- clearly understand the concept of line of symmetry;
- clearly understand terminology and notation used in geometry (e.g., line segment, the use of letters to designate points on a plane);
- accurately use a grid system to construct the symmetrical half of a geometric design; and
- accurately use a grid system to complete a symmetrical geometric design that is composed of four congruent shapes.

Successful student work should provide convincing evidence that the student can use mathematical knowledge to address the relevant issue(s), although the response may not address all details and may contain minor mathematical errors.

APPLICATIONS

How is this relevant?

By successfully answering this question, students demonstrate an understanding of basic geometric concepts (i.e., symmetry and congruence) and of how to use these concepts to solve real-life problems. Students may use these concepts in school and in adult life. For example, students may use these concepts in math, science, and art classes; in describing objects to others; and, when adults, in such occupations as computer-assisted design (CAD), computer-assisted manufacturing (CAM), constructing scale models, artistic design, and architecture.